CLAIMS

1. A hydrodynamic bearing assembly, comprising:

a rotational and stationary members arranged with predetermined gaps to each other, the gaps including a radial gap defined therebetween in a radial direction perpendicular to an axis or a thrust gap defined therebetween in a thrust direction parallel to the axis, the gap containing a fluid for generating a radial or thrust dynamic pressure due to the relative rotation between the rotational and stationary members so that said rotational member rotate relative to said stationary member without any contact;

wherein said rotational and stationary members have opposing surfaces to each other, and any one of the opposing surfaces has grooves formed thereon, the grooves having the depth modified in accordance with its position so that the dynamic pressure generated across the gap is substantially even.

2. The hydrodynamic bearing assembly according to Claim 1:

wherein the grooves on one of opposing surfaces of said rotational and stationary members for generating thrust dynamic pressure to keep both members away from each other in the thrust direction are formed such that the

grooves are shallower towards the downstream flow of the fluid passing therethrough.

3. The hydrodynamic bearing assembly according to Claim 1:

wherein the grooves on one of opposing surfaces of said rotational and stationary members for generating radial dynamic pressure to keep both members away from each other in the radial direction are formed such that the grooves are shallower towards the downstream flow of the fluid passing therethrough.

4. The hydrodynamic bearing assembly according to any one of Claims 1 to 3:

wherein the grooves have the depth modified gradually and smoothly towards the downstream flow of the fluid passing therethrough.

5. The hydrodynamic bearing assembly according to any one of Claims 1 to 3:

wherein the grooves have the depth modified step-by-step towards the downstream flow of the fluid passing therethrough.

6. A hydrodynamic bearing assembly, comprising:

a disk-shaped thrust plate extending in a radial direction perpendicular to a bearing axis;

a circular thrust opposing surface extending in the radial direction and opposing to said thrust plate; and

a thrust bearing for generating the thrust dynamic pressure in a thrust direction parallel to the bearing axis due to a relative rotation between said thrust plate and said thrust opposing surface;

wherein at least one, or both of opposing surfaces of said thrust plate and said thrust opposing surface are inclined such that a distance between both opposing surfaces thereof becomes greater from an inside portion towards an outer portion of the thrust bearing.

7. The hydrodynamic bearing assembly according to Claim 6:

wherein the opposing surface is inclined linearly in the cross section parallel to the bearing axis so that it is in a frustum form.

8. The hydrodynamic bearing assembly according to Claim 6:

wherein the opposing surface is curved as being arc-shaped in the cross section parallel to the bearing axis so that it is in a spherical form.

9. The hydrodynamic bearing assembly according to Claim 6:

wherein the opposing surface is drawn, in the cross section parallel to the bearing axis, as a partial circle having the center provided on a line beneath the innermost portion of the thrust bearing and parallel to the bearing axis.

10. The hydrodynamic bearing assembly according to any one of Claims 6 to 9:

wherein a gradient d defined by a thrust distance difference between the opposing surfaces in the thrust bearing is approximately 2 microns or less.

11. The hydrodynamic bearing assembly according to Claim 6, further comprising:

a radial bearing defined by a column shaft having an outer surface parallel to the axis and a cylindrical hollow sleeve rotatably arranged around the outer surface, said radial bearing for generating the radial dynamic pressure in the radial direction perpendicular to the axis due to the relative rotation between the shaft and the sleeve;

wherein a radial distance s on one side of the thrust bearing defined between the innermost and outermost

portions of the thrust bearing, a gradient d defined by a thrust distance difference between the opposing surfaces in the thrust bearing, a radial length L defined by a length along the axis of said radial bearing, and a total radial gap F of a pair of side radial gaps along a diameter in said radial bearing satisfy the following condition;

$F/L < d/s$.

12. A hydrodynamic bearing assembly, comprising:

a radial bearing including a column shaft having an outer surface parallel to an axis, and a hollow cylindrical sleeve having an inner surface rotatably arranged around the outer surface of said shaft, said radial bearing for generating a radial dynamic pressure due to a relative rotation between said sleeve and said shaft;

a thrust bearings including a thrust plate formed or secured on one end surface of said shaft along the axis, and a thrust opposing surface formed or secured on one end surface of said sleeve along the axis, said thrust bearing for generating a thrust dynamic pressure due to the relative rotation between said thrust plate and said thrust opposing surface; and

a second thrust plate covering said hollow cylindrical sleeve at the other end surface along the axis;

wherein a first gap a defined parallel to the axis

between the other end surface of the shaft and said second thrust plate, and a second gap b defined parallel to the axis between said thrust plate and thrust opposing surface satisfy the following condition;

$a < b$.

13. The hydrodynamic bearing assembly according to Claim 12:

wherein the first and second gaps a, b further satisfy the following condition;

$b - a \leq 2$ microns.

14. The hydrodynamic bearing assembly according to Claim 12:

wherein the first and second gaps a, b further satisfy the following condition;

$b - a \leq 0.5$ microns.

15. The hydrodynamic bearing assembly according to any one of Claims 12 to 14:

wherein a perpendicularity between said shaft and said thrust plate formed or secured thereon is approximately 0.7 microns/20 millimeters.

16. The hydrodynamic bearing assembly according to any one

of Claims 12 to 15:

wherein grooves for generating a thrust dynamic pressure due to the relative rotation between said second thrust plate and the other end surface of said shaft are formed on any one of said second thrust plate and the other end surface of said shaft.

17. The hydrodynamic bearing assembly according to any one of Claims 12 to 15:

wherein any one of said second thrust plate and the other end surface of said shaft has a spherical, cone, or frustum boss.

18. The hydrodynamic bearing assembly according to any one of Claims 1 to 17:

wherein one or more of opposing portions among said shaft, said sleeve, said thrust plate, and said thrust opposing surface, and said second thrust plate are made of ceramics material.

19. The hydrodynamic bearing assembly according to Claim 18:

wherein the ceramics material is selected from a group consisting of alumina, zirconia, silicon carbide, silicon nitride, and sialon.

20. A spindle motor incorporating the hydrodynamic bearing assembly according to any one of Claims 1 to 19.

21. A memory device or a bar code scan reader incorporating the spindle motor according to Claim 43 or 44.

22. A process for preventing a dew generated in a hydrodynamic bearing assembly, in which a rotational and stationary members having opposing surfaces are arranged with predetermined gaps therebetween in a radial direction perpendicular to an axis and in a thrust direction parallel to the axis, and a fluid intervening in the gaps generates dynamic pressures due to the relative rotation between the rotational and stationary members so that the rotational member can be rotated without any contact to the stationary member, said process comprising the steps of:

modifying a depth of the grooves formed on either rotational and stationary members in accordance with a position of the grooves to cause a dynamic pressure distribution to be kept substantially even, to reduce the peak pressure required to obtain a floating force, thereby to prevent the dew from being generated because of the compression in the opposing surfaces.